0009

WATER QUALITY MEMORANDUM

Utah Coal Regulatory Program

January 18, 2008

gK

TO: Internal File

THRU: Pamela Grubaugh-Littig, Permit Supervisor pgl

FROM: DD Dana Dean, P.E., Senior Reclamation Hydrologist

RE: 2006 Fourth Quarter Water Monitoring, Genwal Resources, Inc., Crandall Canyon Mine, C/015/0032-WQ-06-4 Task #2731

The Crandall Canyon Mine was conducting continuous miner retreat mining in barrier pillars along the mains during the second quarter of 2007. Water monitoring requirements can be found in Section 7.31.21, and 7.31.22 of the MRP, especially Tables 7-4, 7-5, 7-8, 7-9, and 7-10.

1. Was data submitted for all of the MRP required sites? YES ☒ NO ☐

Springs

The MRP requires the Permittee to monitor 24 springs each quarter. Some require full laboratory analysis according to Table 7-4, while others simply require field measurements.

The Permittee submitted all required samples for the spring sites.

Streams

The MRP requires the Permittee to monitor12 streams each quarter. Some require full laboratory analysis according to Table 7-8, while others simply require field measurements.

The Permittee submitted all required samples for the stream sites.

Wells

The MRP requires the Permittee to monitor 7 wells during the second quarter. All require full laboratory analysis according to Table 7-4.

The Permittee submitted all required samples for the wells. Two were dry, and five were in-mine wells located in now inaccessible areas of the mine.

UPDES

The UPDES Permit/MRP require monthly monitoring of 2 outfalls: 001,sed. pond discharge, and 002, mine water discharge.

The Permittee submitted all required samples for the UPDES sites. Outfall 001 reported no flow.

2. Were all required parameters reported for each site? YES ☒ NO ☐

3. Were any irregularities found in the data? YES ☒ NO ☐

Some parameters fell outside of two standard deviations from the mean encountered at the respective sites. They were:

Site	Parameter	Value	Standard Deviations from Mean	Mean
LOF-1	Total Hardness	446 mg/L	2.08	310.51 mg/L
LOF-1	Sulfate	185 mg/L	2.04	75.78 mg/L
UPF-1	Total Hardness	452 mg/L	2.08	297.89 mg/L
UPF-1	Total Dissolved Solids	532 mg/L	2.09	320.04 mg/L
LB-12	Water Temperature	7.8 °C	2.45	9.80 °C
SP1-47	Flow	80.7 gpm	13.42	6.49 gpm
SP-58	Total Hardness	434 mg/L	2.05	311.72 mg/L
UT-0024368-002 – Oct 26	Specific Conductivity	926 µmhos/cm	2.15	755.46 µmhos/cm
UT-0024368-002 – Nov 21	Specific Conductivity	957 µmhos/cm	2.54	755.46 µmhos/cm

As described by the Permittee, there was a "copious amount of snowmelt" above SP1-47 at the time of sampling, contributing to the unusually high flow reading.

There is a weak upward trend in the specific conductivity at Outfall 002 ($R^2 = 0.23$), with no real correlation to flow. There is no standard for specific conductivity, but it is closely related to total dissolved solids (TDS). The total dissolved solids concentration at Outfall 002 has no trend and is within the expected range.

There is a strong upward trend in sulfate at LOF-1 ($R^2 = 0.8005$). Sulfate is not toxic to plants or animals (even at very high concentration), but has a cathartic effect on humans in concentrations over 500 mg/L. For this reason, the EPA has set the secondary standard as 250 mg/L. The sulfate at LOF-1 has always been less than 200 mg/L, and the concentrations upstream of the mine are very similar to those downstream of the mine.

There is a fairly strong upward trend in total dissolved solids at UPF-1 ($R^2 = 0.5751$). This has affected the TDS at LOF-1, which has a very similar trend. UPF-1 is upstream of all mine activity.

There is a fairly strong upward trend in total hardness at UPF-1 ($R^2 = 0.7458$), LOF-1 ($R^2 =$ 0. 5428), and SP-58 ($R^2 = 0.6367$). The concentrations have always fallen into the hard (150-300 mg/L – 38 of 70 samples) or very hard ranges (>300 mg/l –32 of 70 samples). For the Crandall Canyon Flumes, the upstream values are similar to the downstream values.

Many routine reliability checks fell outside of standard values:

Site	Reliability Check	Value Should Be...	Value is...
BCF	Conductivity/Cations	>90 & < 110	79
BCF	K/(Na + K)	< 20%	45%
BCF	Mg/(Ca + Mg)	< 40 %	52%
BCF	Na/(Na + Cl)	> 50%	24%
Horse Canyon Creek	Conductivity/Cations	>90 & < 110	77
Horse Canyon Creek	K/(Na + K)	< 20%	37%
Horse Canyon Creek	Mg/(Ca + Mg)	< 40 %	50%
IBC-1	Conductivity/Cations	>90 & < 110	79
IBC-1	K/(Na + K)	< 20%	37%
IBC-1	Mg/(Ca + Mg)	< 40 %	56%
IBC-1	Na/(Na + Cl)	> 50%	29%
Indian Creek	Conductivity/Cations	>90 & < 110	80
Indian Creek	K/(Na + K)	< 20%	42%
Indian Creek	Na/(Na + Cl)	> 50%	27%
Little Bear Creek	Conductivity/Cations	>90 & < 110	81
Little Bear Creek	K/(Na + K)	< 20%	40%
Little Bear Creek	Mg/(Ca + Mg)	< 40 %	53%
Little Bear Creek	Na/(Na + Cl)	> 50%	23%
LOF-1	Conductivity/Cations	>90 & < 110	80
LOF-1	K/(Na + K)	< 20%	37%
LOF-1	Mg/(Ca + Mg)	< 40 %	49%
LOF-1	Na/(Na + Cl)	> 50%	41%
Section 4 Creek	Conductivity/Cations	>90 & < 110	77
Section 4 Creek	K/(Na + K)	< 20%	43%
Section 4 Creek	Mg/(Ca + Mg)	< 40 %	61%

Section 4 Creek	Na/(Na + Cl)	> 50%	24%
Section 5 Creek	Conductivity/Cations	>90 & < 110	80
Section 5 Creek	K/(Na + K)	< 20%	36%
Section 5 Creek	Mg/(Ca + Mg)	< 40 %	59%
Section 5 Creek	Na/(Na + Cl)	> 50%	26%
UPF-1	Conductivity/Cations	>90 & < 110	78
UPF-1	K/(Na + K)	< 20%	46%
UPF-1	Mg/(Ca + Mg)	< 40 %	45%
UPF-1	Na/(Na + Cl)	> 50%	34%
LB5-A	Conductivity/Cations	>90 & < 110	80
LB5-A	K/(Na + K)	< 20%	40%
LB5-A	Mg/(Ca + Mg)	< 40 %	50%
LB5-A	Na/(Na + Cl)	> 50%	26%
Little Bear Spring	Conductivity/Cations	>90 & < 110	80
Little Bear Spring	K/(Na + K)	< 20%	38%
Little Bear Spring	Mg/(Ca + Mg)	< 40 %	47%
Little Bear Spring	Na/(Na + Cl)	> 50%	33%
SP1-33	Conductivity/Cations	>90 & < 110	80
SP1-33	K/(Na + K)	< 20%	40%
SP1-33	Na/(Na + Cl)	> 50%	36%
SP1-9	Conductivity/Cations	>90 & < 110	86
SP1-9	K/(Na + K)	< 20%	61%
SP1-9	Na/(Na + Cl)	> 50%	23%
SP2-24	Cation/Anion Balance	< 5%	9.33%
SP2-24	Conductivity/Cations	>90 & < 110	89
SP2-24	K/(Na + K)	< 20%	91%
SP2-24	Na/(Na + Cl)	> 50%	9%
SP2-9	Conductivity/Cations	>90 & < 110	85
SP2-9	K/(Na + K)	< 20%	63%
SP2-9	Na/(Na + Cl)	> 50%	18%
SP-36	Conductivity/Cations	>90 & < 110	79
SP-36	K/(Na + K)	< 20%	33%
SP-36	Mg/(Ca + Mg)	< 40 %	55%
SP-36	Na/(Na + Cl)	> 50%	22%
SP-58	Conductivity/Cations	>90 & < 110	80
SP-58	K/(Na + K)	< 20%	53%
SP-58	Mg/(Ca + Mg)	< 40 %	43%
SP-58	Na/(Na + Cl)	> 50%	31%
SP-79	Conductivity/Cations	>90 & < 110	77
SP-79	K/(Na + K)	< 20%	48%
SP-79	Mg/(Ca + Mg)	< 40 %	62%

SP-79	$Ca/(Ca + SO_4)$	>50%	48%
SP-79	$Na/(Na + Cl)$	> 50%	24%

These inconsistencies do not necessarily mean that a sample is wrong, but it does indicate that something is unusual. An analysis and explanation of the inconsistencies by the Permittee would help to increase the Division's confidence in the samples. The Permittee should work with the lab to make sure that samples pass all quality checks so that the reliability of the samples does not come into question. The Permittee can learn more about these reliability checks and some of the geological and other factors that could influence them by reading Chapter 4 of *Water Quality Data: Analysis and Interpretation* by Arthur W. Hounslow. A geological influence is most likely here, since most samples have the same inconsistencies, and they recur each quarter.

4. On what date does the MRP require a five-year re-sampling of baseline water data.

Page 7-33 of the MRP states that groundwater samples collected during the low flow period every 5 years will be analyzed for baseline parameters.

Page 7-35 of the MRP states that surface water samples collected during the low flow period every 5 years will be analyzed for baseline parameters.

Therefore, the next re-sampling of baseline parameters is required by the fourth quarter of 2010.

5. Based on your review, what further actions, if any, do you recommend?

No further actions are necessary at this time.

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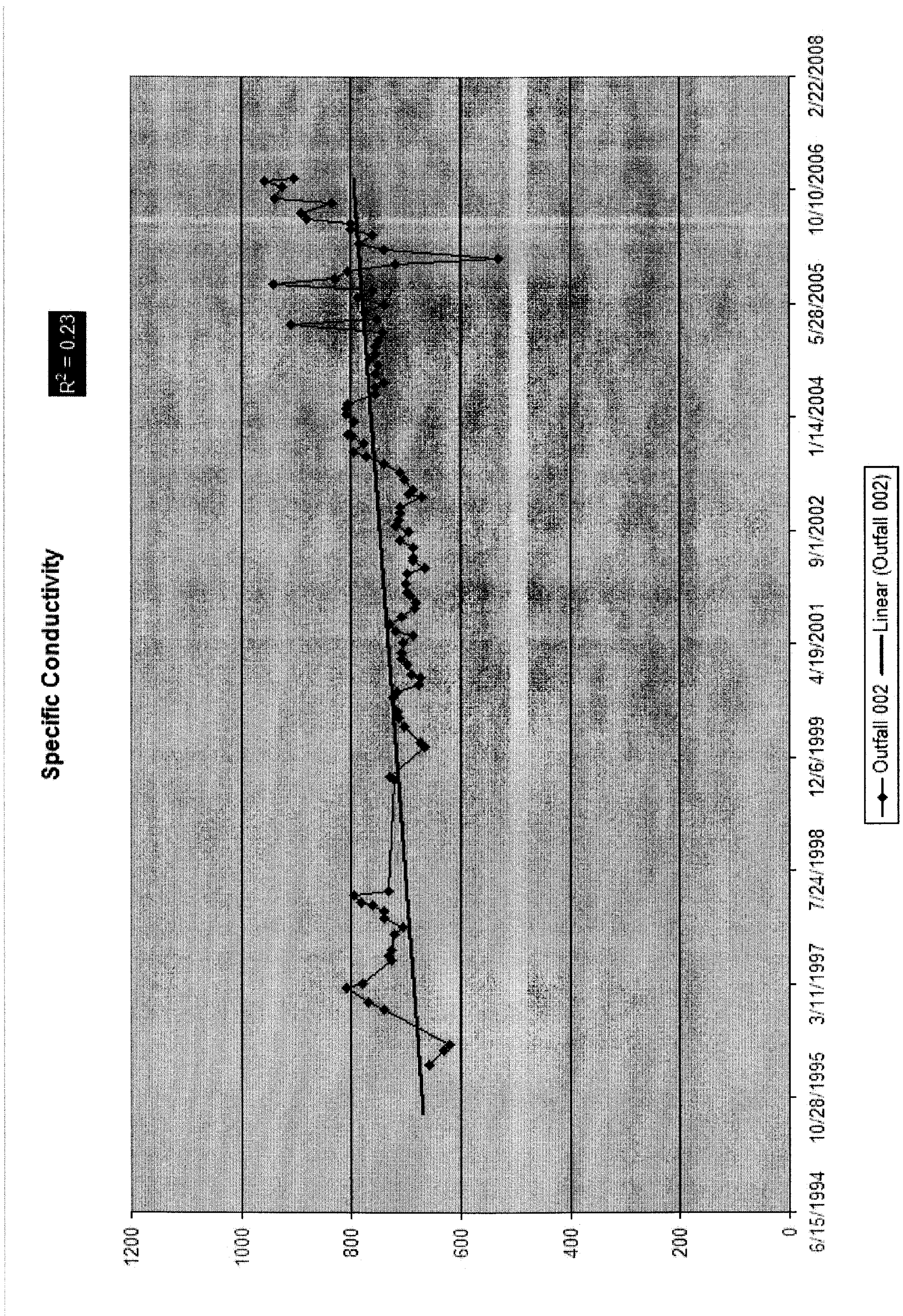
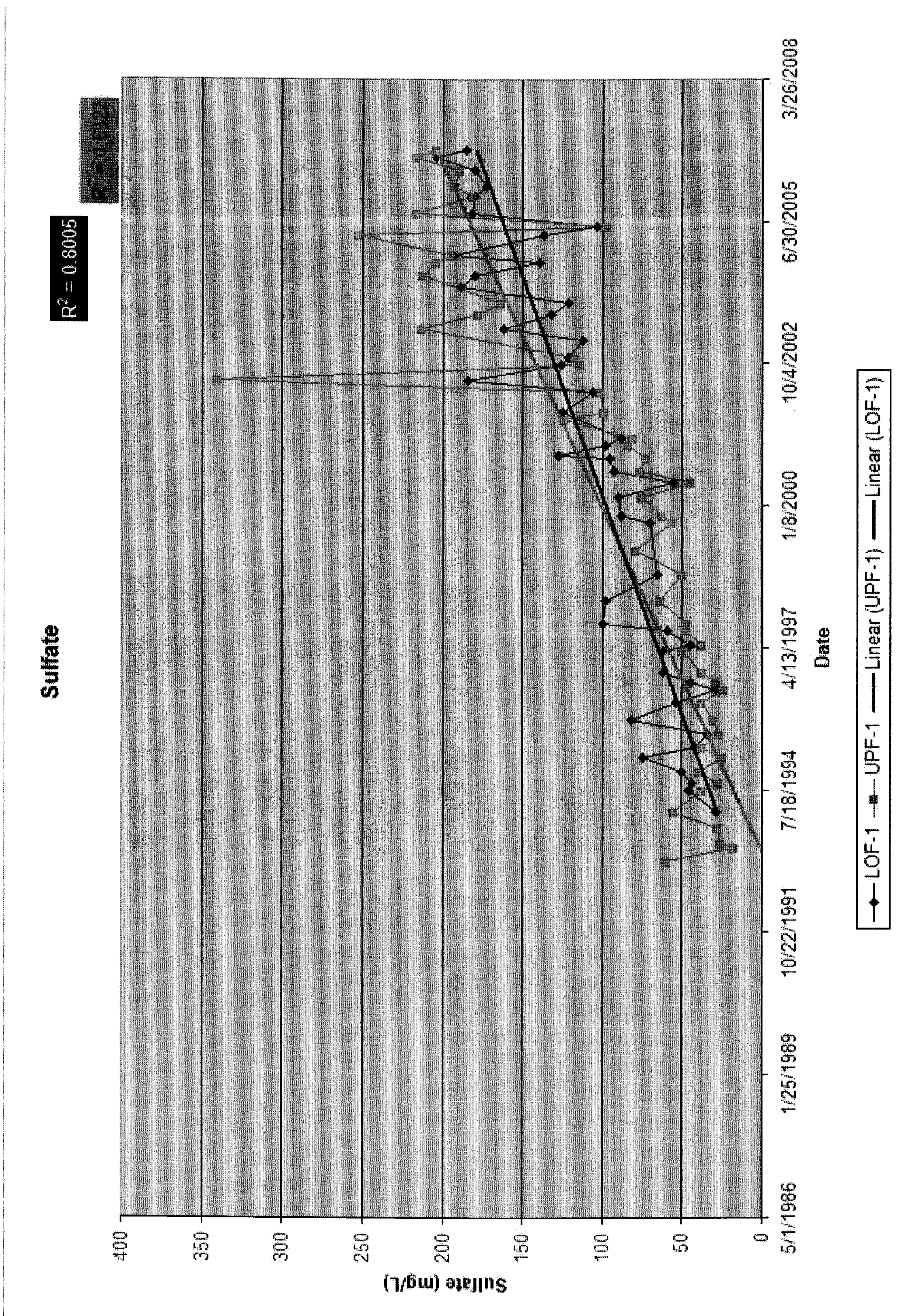
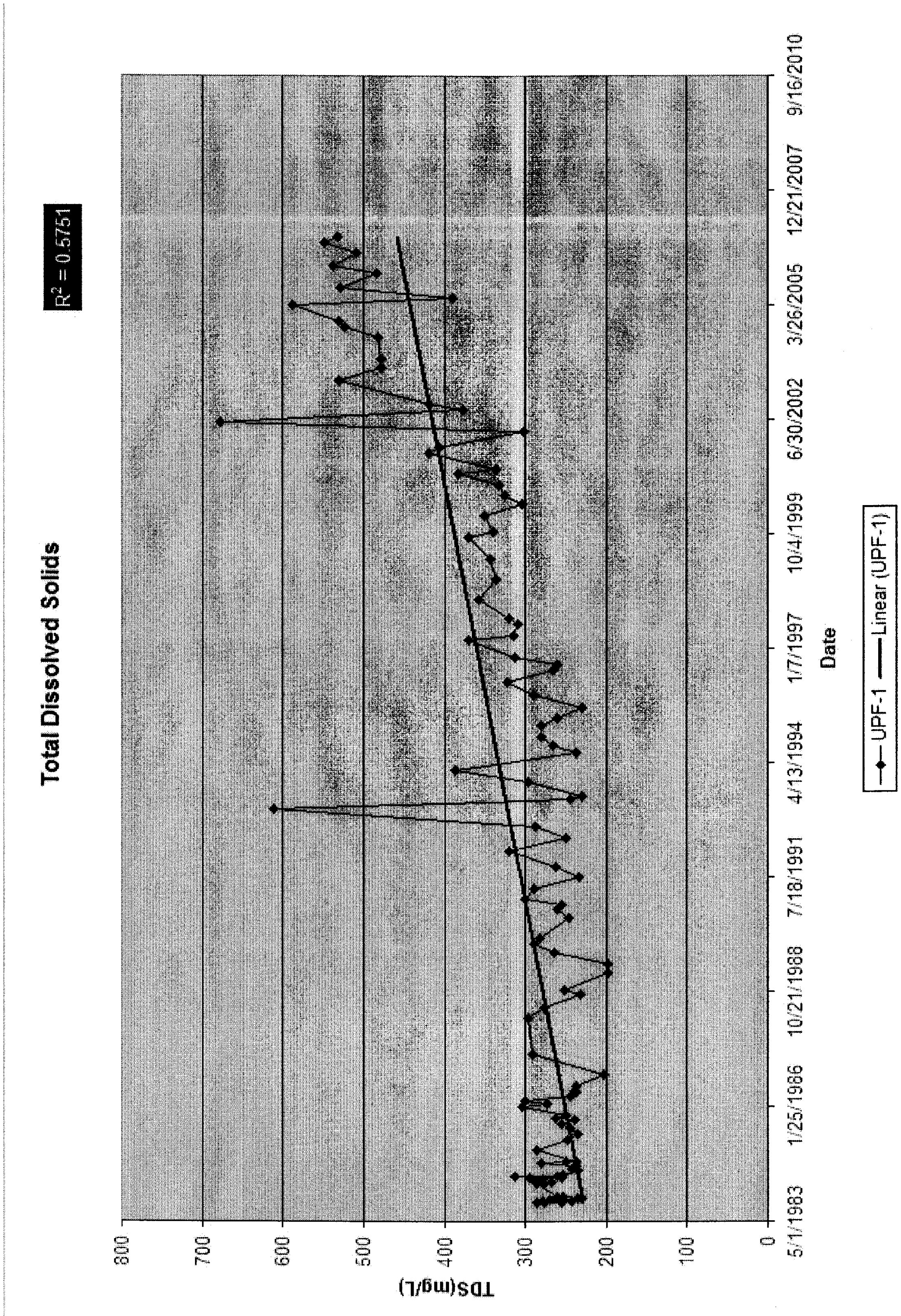
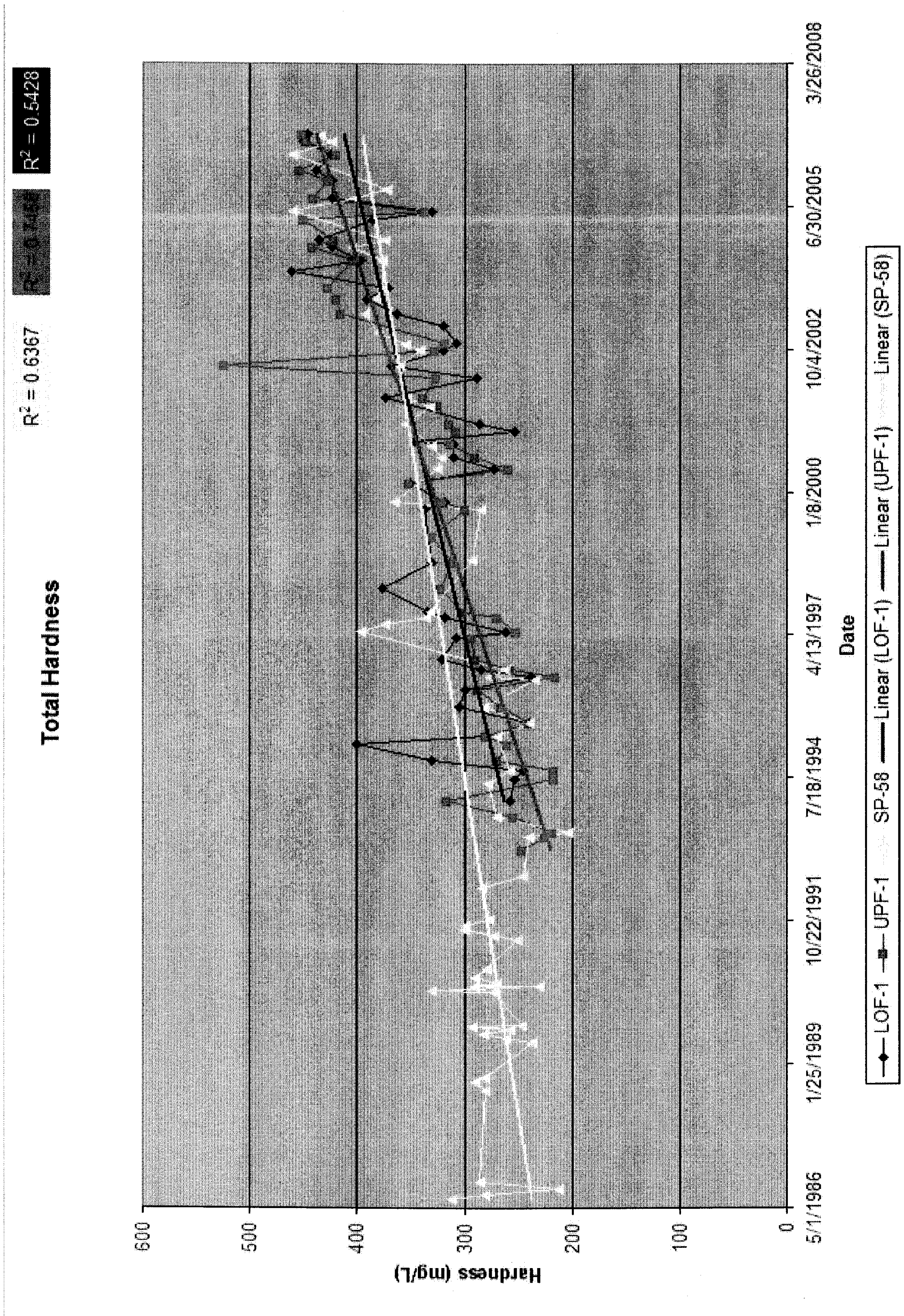



Sulfate
$R^2 = 0.8005$
Sulfate (mg/L)
0
50
100
150
200
250
300
350
400
5/1/1986
1/25/1989
10/22/1991
7/18/1994
4/13/1997
1/8/2000
10/4/2002
6/30/2005
3/26/2008
Date
LOF-1
UPF-1
Linear (UPF-1)
Linear (LOF-1)


Total Dissolved Solids
$R^2 = 0.5751$
TDS(mg/L)
800
700
600
500
400
300
200
100
0
5/1/1983
1/25/1986
10/21/1988
7/18/1991
4/13/1994
1/7/1997
10/4/1999
6/30/2002
3/26/2005
12/21/2007
9/16/2010
Date
UPF-1
Linear (UPF-1)


Total Hardness
$R^2 = 0.6367$
$R^2 = 0.5428$
Hardness (mg/L)
600
500
400
300
200
100
0
5/1/1986
1/25/1989
10/22/1991
7/18/1994
4/13/1997
1/8/2000
10/4/2002
6/30/2005
3/26/2008
Date
LOF-1
UPF-1
SP-58
Linear (LOF-1)
Linear (UPF-1)
Linear (SP-58)